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AMMUNITION STORAGE STUDY REPORT

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This report describes a study of ammunition storage sites conducted for the Industrial Operations Command Industrial Complexes Sub-process Action Team. The major part of the study consisted of using decision analysis techniques to construct a rank ordering of sites capable of performing an ammunition storage mission.

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SUMMARY

PURPOSE

This report discusses work done for the Industrial Operations Command (IOC) Industrial Complexes Sub-Process Action Team (PAT). The objective of the study was to re-examine ammunition storage capabilities considering known base closures and to provide input for management decisions involving the utilization, realignment and investment in ammunition storage sites.

APPROACH

The study consists of an assessment of ammunition storage requirements versus space availability and a decision analysis which was used to rank order sites capable of performing a depot storage mission and Government-owned, Contractor-operated (GOCO) sites which could be used to store ammunition.

CONCLUSIONS

1. Based on the ranking of depot type sites, Base Realignment and Closure Committee (BRAC) I, closure of depot activities seems reasonable.

2. In the near term, all ammunition storage is needed and future closure options are limited. In the long term, the storage crunch will be solved by the downsizing of the armed forces.

3. Greater emphasis should be given to investing to balance capabilities: for example, Hawthorne Army Ammunition Plant (HWAAP) is 1st in storage capability but 11th outloading via container.

4. Some type of formal decision analysis which addresses which sites to be utilized should be used in the management process.

5. Increased demilitarization is needed to provide storage space and reduce operation and support costs.

6. If the storage base were to be expanded by utilizing the seven GOCO plants ranked in this study, then Ravenna Army Ammunition Plant would be recommended over the other six plants. However, a significantly better long term solution may be achieved by making a relatively small investment to expand the storage capability of the current storage base.

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1. BACKGROUND: In December 1990, the IOC Industrial Complexes Sub-PAT tasked the Systems Analysis Office to perform an assessment of ammunition storage sites, storage requirements, space availability and potential impacts resulting from various consolidation efforts. The major part of this study consisted of generating selection criteria, gathering data and using decision analysis techniques to construct a rank ordering of sites capable of performing a depot ammunition storage mission. This study was coordinated with U.S. Army Defense Ammunition Center and School (USADACS) and does not duplicate any effort they are currently making.

2. OBJECTIVES: To re-examine ammunition storage capabilities considering known base closures (depot activities, AAPs, ect). To provide input for management decisions involving the utilization, realignment and investment in ammunition storage sites.

3. STORAGE REQUIREMENT VERSUS STORAGE AVAILABILITY:

a. The total ammunition storage space to be inactivated exceeds 4.7 million square feet. Known installation realignments which will impact the FY 90 storage baseline are given below:

(1) Depots (BRAC I)

	NET STORAGE SPACE IN SQ FT [1]
Umatilla	459,000
Pueblo	1,121,000
Navajo	503,000
Ft Wingate	232,000
Coosa River	230,000

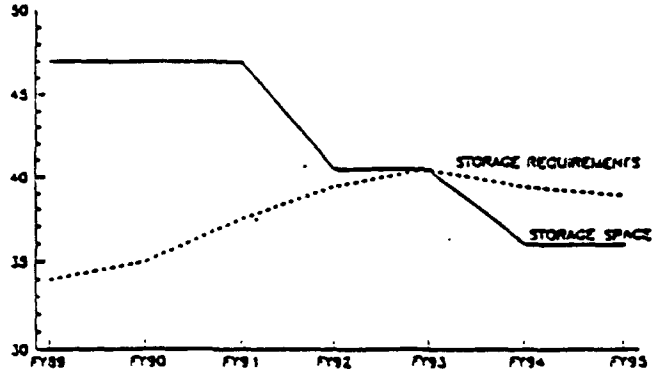
(2) BRAC II (AMC Plan)

	INDUSTRIAL	WHOLESALE
Indiana	247,000	185,000
Joliet	605,000	-
Kansas	368,000	43,000
Longhorn	209,000	67,000
Mississippi	35,000	20,000
Newport	83,000	-
Louisiana	183,000	14,000
Sunflower	161,000	-

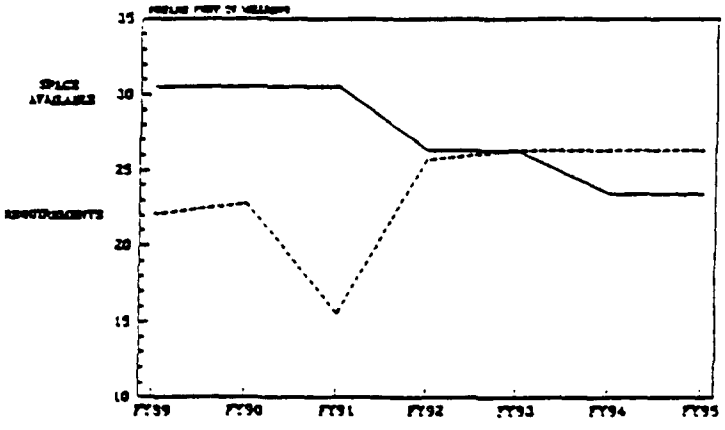
b. PROJECTED STORAGE SHORTFALL (SURPLUS): The charts on the following page show the projected shortfall (surplus) of storage space as of December 1990, March 1991, and October 1991. The source for all of these charts was AMSMC-DS. The requirements line is a function of projected changes in CONUS

NET SPACE VS PROJECTED REQUIREMENTS

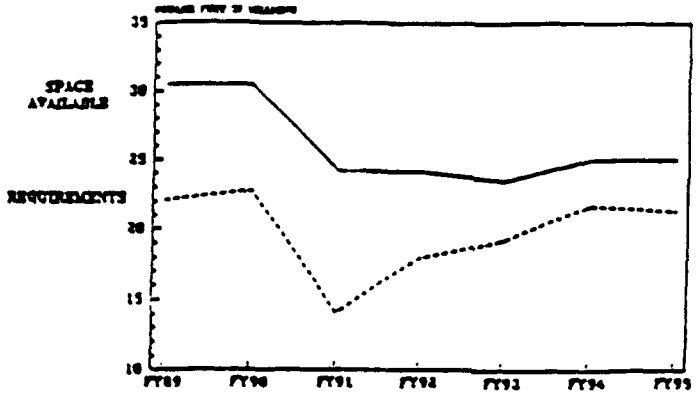
NET SQ FT IN MILLIONS



STORAGE REQUIREMENTS VS SPACE AVAILABILITY
WORST CASE SCENARIO
1 MARCH 1991



STORAGE REQUIREMENTS VS SPACE AVAILABILITY
CURRENT CONDITIONS
1 OCT 1991



training, retrograde, OCONUS war reserves, industrial stocks, other service stocks, and projected production requirements. The space availability line is a function of the gross to net storage ratio, the sites included in the storage base, losses from BRAC I and BRAC II as well as the effect of various management initiatives. Because this type of analysis involves numerous estimates the results can change dramatically as better information becomes available. The December 1990 chart (top of page 2) projected FY 95 requirements to be 108 percent of space availability. It was one of the reasons for initiating this study. The October 1991 analysis projects FY 95 requirements to be 85 percent of space availability.

c. FACTORS THAT WILL HELP EASE THE STRAIN ON THE STORAGE BASE:

(1) Improved utilization of storage space thru rewarehousing.

(2) Upgrade of "Y" sites at Tooele, Sierra, and Hawthorne.

(3) Purge the system of older weapon systems and ammunition items.

(4) Utilizing GOCO space for interim storage rather than shipping to a depot.

(5) Consolidation of special weapons stock.

(6) The impact of downsizing of the armed forces. The current Pentagon plan [2] calls for reducing the Army from its 5 corps, 28 division strength to 4 corps and 20 divisions. This smaller Army would have about two-thirds the number of active soldiers in today's force with a smaller requirement for ammunition and ammunition storage.

(7) The impact of future toxic chemical munitions and nuclear arms reductions.

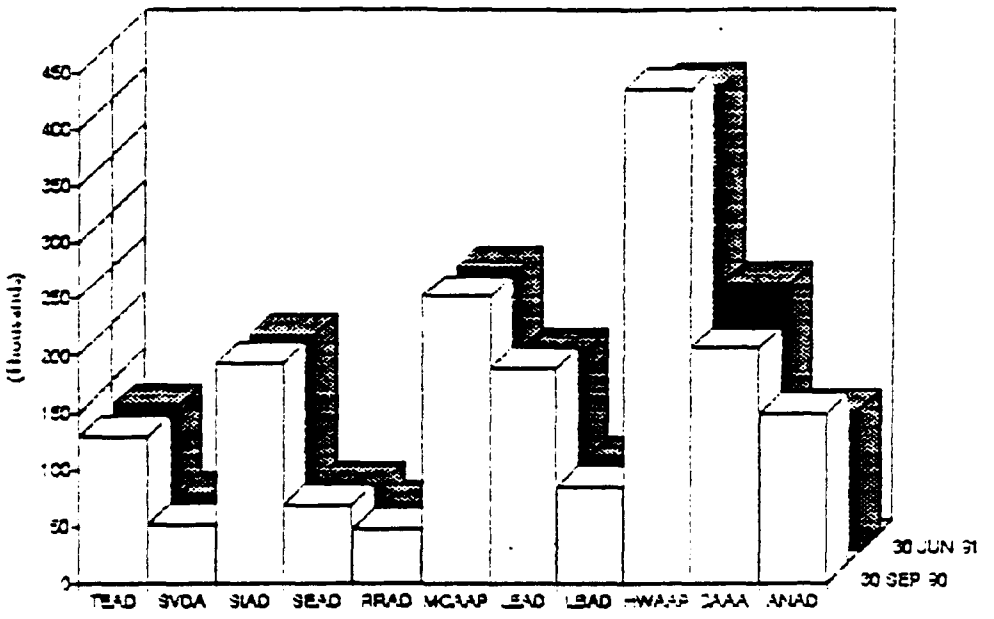
(8) Increased utilization of Milan as a wholesale storage site.

(9) Utilization of Navajo which is to be operated by the National Guard.

(10) Reducing outleasing and outgrants which will free up storage space.

(11) Increasing the amount of Demilitarization: The comparison of the June 1991 and 30 September 1990 Ammunition Storage Manager's Handbooks indicates that the amount of ammunition storage occupied by demilitarization is approximately the same as it was in September 1990. The amount of storage space occupied by demilitarization at the sites making up the AMCCOM wholesale storage base is provided below. The growth from new demilitarization has tended to offset whatever progress has been made in disposing of demilitarization. There is potentially over 2 million square feet available thru demilitarization.

AMMUNITION STORAGE SPACE
SQUARE FEET OCCUPIED BY DEMIL



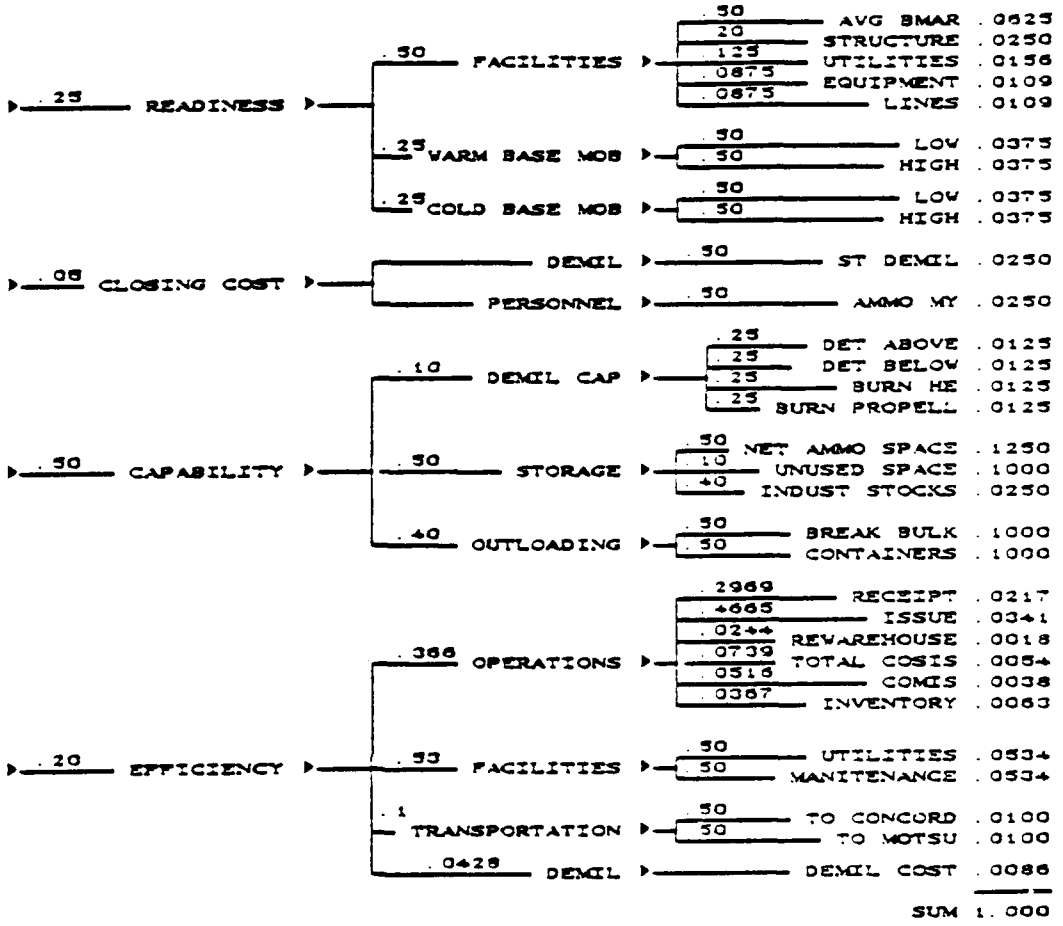
4. RANK ORDERING OF SITES CAPABLE OF PERFORMING A DEPOT STORAGE MISSION: In order to assess the remaining storage base and the realignment decisions already made, those sites capable of performing a depot storage mission were ranked ordered. The methodology used to rank order sites consisted of the following five steps:

a. STEP 1. GENERATION OF A LIST OF ALTERNATIVE SITES. The list of sites used in this analysis was developed by managers from the Defense Ammunition Directorate, the Production Directorate, and the IOC Industrial Complexes Sub-PAT. It consists of sites capable of performing a depot storage mission. It includes all BRAC I depot sites with the exception of Navajo, which was not included because of lack of data. The sites are provided below:

Anniston	Lexington-Bluegrass	Ravenna	Tooele
Crane	McAlester	Red River	Umatilla
Ft. Wingate	Milan	Savanna	
Hawthorne	Pine Bluff	Seneca	
Letterkenny	Pueblo	Sierra	

b. STEP 2. DETERMINATION OF THE SELECTION CRITERIA. A value tree [4] was constructed to assist in developing the criteria and weights. Managers from the Defense Ammunition and Production Directorates were asked to provide general values relevant to selecting an ammunition storage site. These categories were disaggregated until attributes were developed which were measurable or easy to assess judgmentally. The value tree used for this analysis is provided below.

Value Tree for Ammunition Mission at Depots

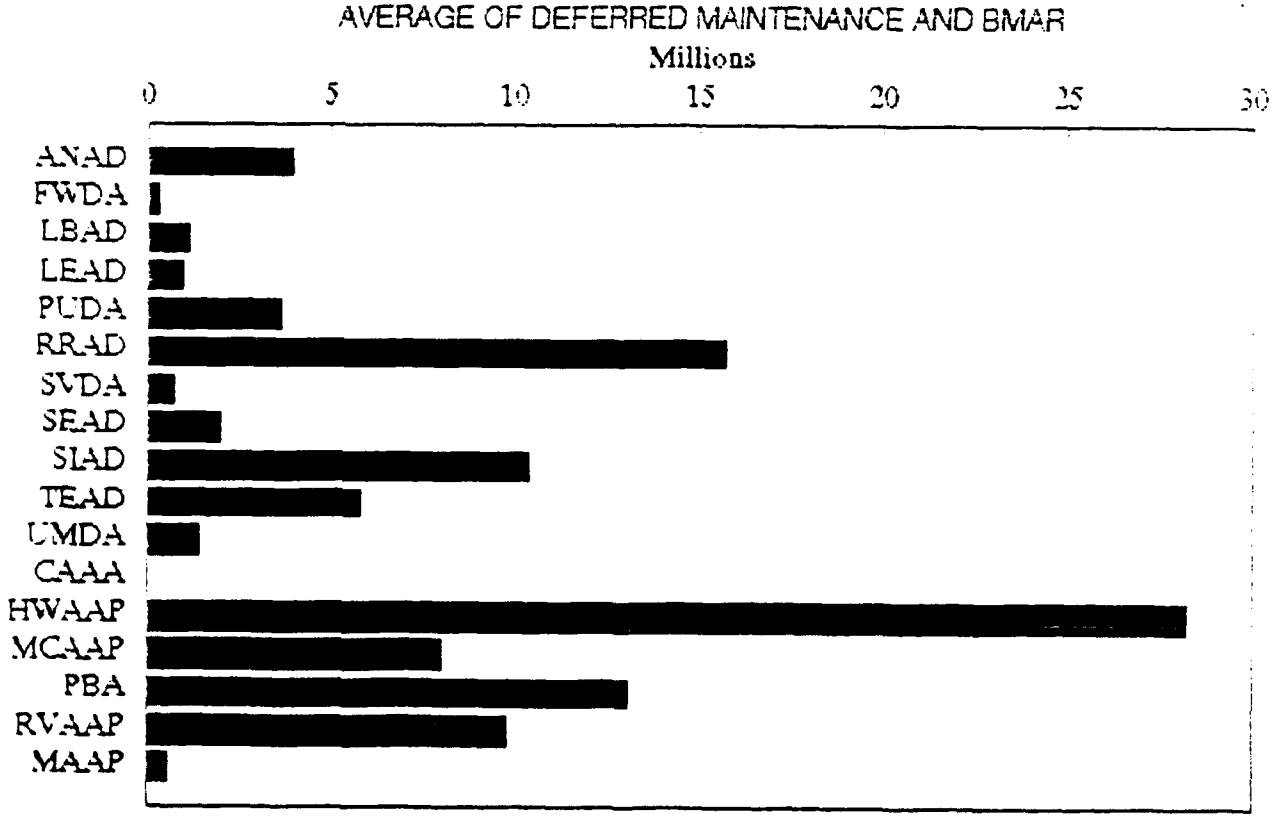


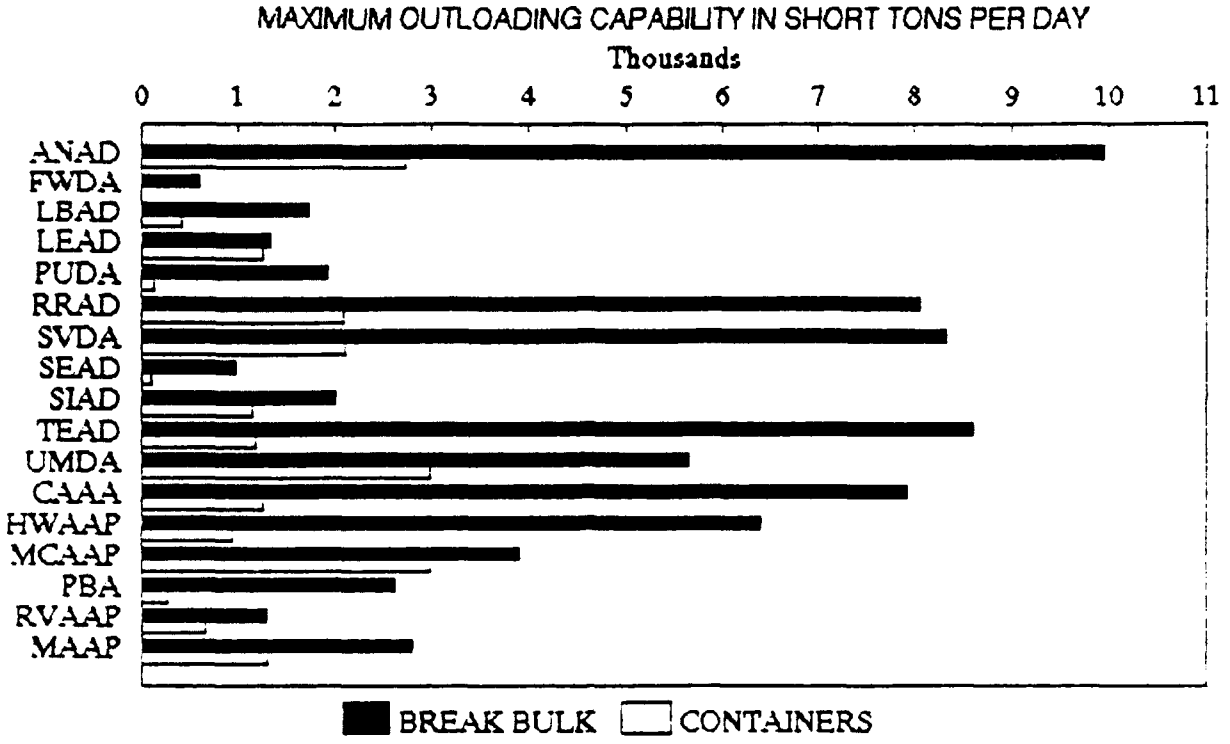
The layer on the top (left side) of the tree contains very general, and somewhat vague, values. As the tree branches, the values become more specific in the lower layers (right side) of the tree. Weights were then assessed for the major branches by eliciting their relative importance from the managers and normalizing them to add to 1.0. The same procedure was followed for the categories on the lower branches. The weights on the attribute level were obtained by multiplying through the tree. For example, the weight for AVG BMAR was obtained by multiplying the normalized weight for Readiness (.25) by the normalized weight for Facilities (.50) and then by the normalized weight for Avg BMAR (.50) to yield 0.0625.

c. STEP 3. DATA COLLECTION. A definition of each attribute and the source of its value is provided in the appendix. A listing of attributes making up a majority of the assigned weight is provided below:

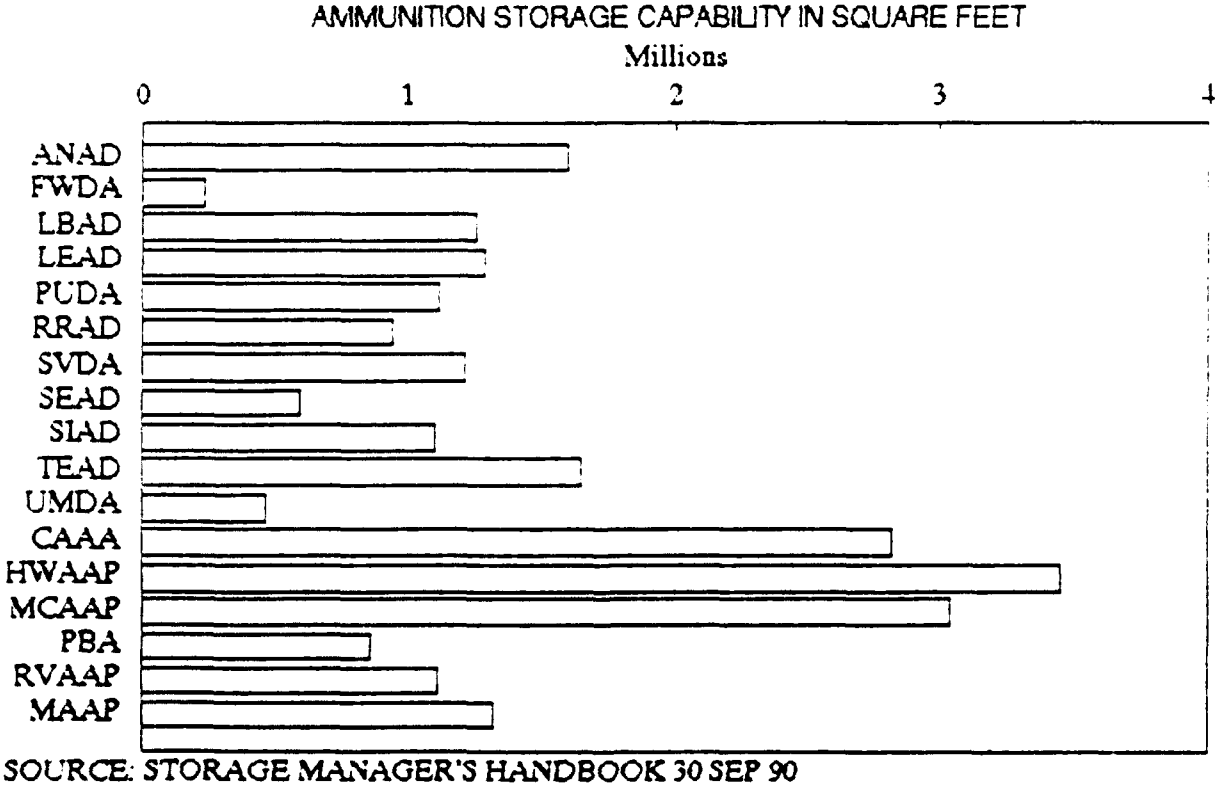
ATTRIBUTE	WEIGHT	CUM WEIGHT
Total ammunition storage	0.1250	0.1250
Unused ammunition storage	0.1000	0.2250
Outloading via containers	0.1000	0.3250
Outloading via break bulk	0.1000	0.4250
BMAR	0.0625	0.4875
Maintenance cost	0.0491	0.5366
Utilities cost	0.0491	0.5857

Data values for the net storage space, BMAR, and outloading capabilities of each site are provided in the graphs below:



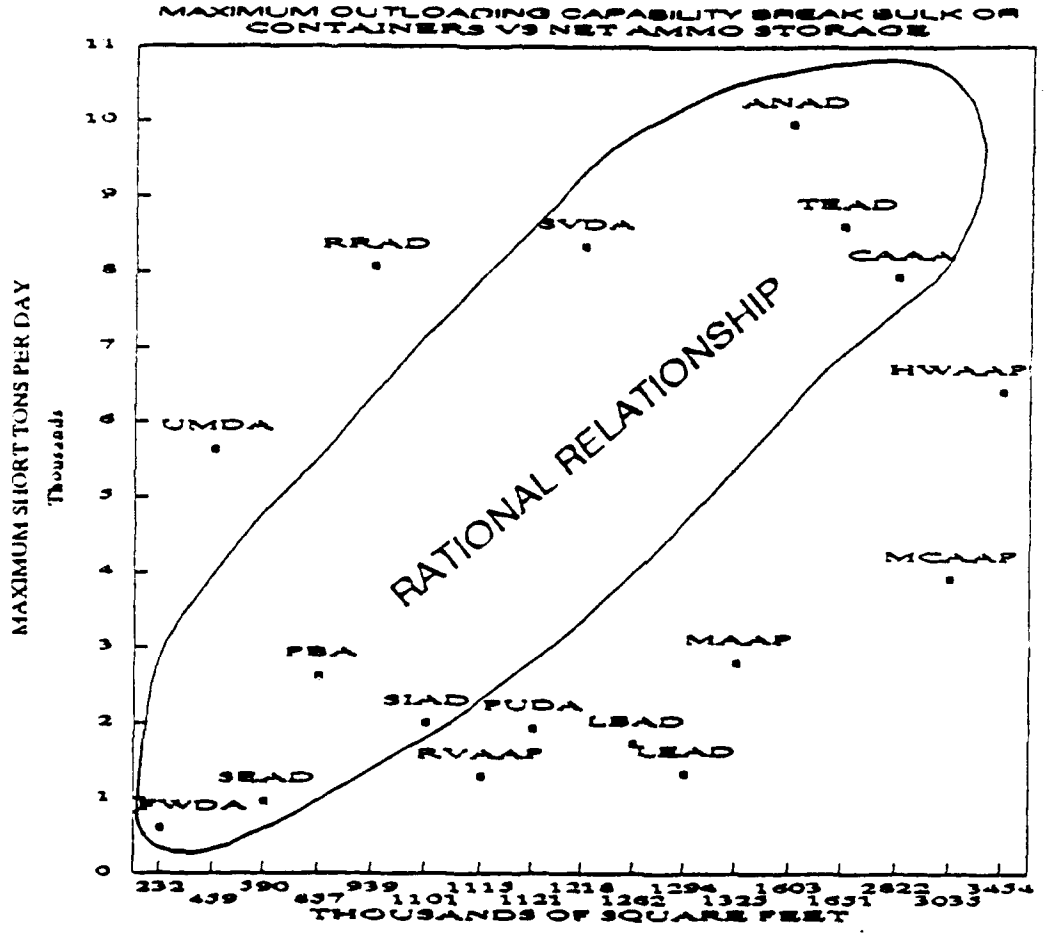


HWAAP OUTLOADED 3000 ST/DAY DURING DESERT STORM



SOURCE: STORAGE MANAGER'S HANDBOOK 30 SEP 90

A scatter diagram of outloading capability versus net ammunition storage space is provided below. There is a lack of balance between the various site's outloading capability and storage capacity. For example McAlester which has one of the largest storage capacities has less outloading capability than Umatilla. A similar lack of balance exists between demilitarization capability and storage capacity.



d. STEP 4. GENERATION OF A RANK ORDER LIST. The method used to combine the data values and weights to generate a rank ordering of the sites was the Technique for Ordered Preference by Similarity to Ideal Solution TOPSIS [5,6]. The TOPSIS algorithm is based upon the concept that the preferred alternative is the one having the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution. The ideal solution is composed of the best attribute values among the alternatives and the negative-ideal solution is made up of the worst attribute values. TOPSIS generates a preference order considering both the distances of each alternative from the

.deal solution and the negative-ideal solutions simultaneously by taking the relative closeness to the ideal solution. The ideal solution has a TOPSIS score of 1.0 and the negative-ideal solution has a TOPSIS score of 0.0. The TOPSIS score for each site is given on the following page. It is important to note that the scores are based on a site's ability to perform an ammunition storage mission. Many installations have a dual-use mission which influence their fate. This does not imply that the ammunition storage mission could not be changed; only that other installation missions influence any potential restructure. When these dual-use missions are taken into consideration BRAC I decisions seem reasonable.

SITE	SCORE	NON-AMMUNITION STORAGE MISSION
Crane	0.71	Active AAP
McAlester	0.66	Active AAP
Savanna	0.61	USADACS
Anniston	0.61	Maintenance Depot
Hawthorne	0.59	WADF
Tooele	0.52	Maintenance Depot
Umatilla	0.49	None*
Milan	0.48	Active AAP
Letterkenny	0.47	Maintenance Depot
Red River	0.47	Maintenance Depot
Pueblo	0.44	None*
Lexington-Bluegrass	0.44	None
Sierra	0.42	Nuclear
Seneca	0.37	Nuclear
Ft Wingate	0.37	None*
Ravenna	0.37	Industrial stock storage
Pine Bluff	0.32	Chemical, Smoke, Masks

* BRAC I

e. STEP 5. SENSITIVITY ANALYSIS. Sensitivity analysis was conducted on the weights given to unused ammunition storage, BMAR, efficiency, and outloading. The rankings are somewhat insensitive to changes to these weights. Although the rankings changed, most locations stayed in their relative groups. Two noteworthy changed occured when the attributes associated with outloading were dropped. Ravenna rose from an initial rank of 16 to a rank of 11 and Umatilla dropped from an initial rank of 7 to a rank of 15. A description of each sensitivity run is provided below.

(1) The attribute unused ammunition storage was dropped. In one ranking, the weight previously given to unused ammunition storage was given to total ammunition storage. In a second ranking, the weight was redistributed among all the remaining attributes. The results are provided on the following page.

SITE	INITIAL SCORE	REDISTRIBUTE WEIGHT	WEIGHT TO TOTAL AMMUNITION
CAAA	0.708	0.680	0.717
MCAAP	0.664	0.652	0.708
SVDA	0.612	0.604	0.511
ANAD	0.605	0.661	0.583
HWAAP	0.593	0.554	0.652
TEAD	0.521	0.576	0.530
UMDA	0.494	0.548	0.432
MAAP	0.479	0.473	0.432
LEAD	0.471	0.499	0.449
RRAD	0.467	0.499	0.418
PUDA	0.444	0.449	0.401
LBAD	0.442	0.468	0.426
SIAD	0.417	0.457	0.399
SEAD	0.374	0.402	0.335
FWDA	0.373	0.402	0.325
RAAP	0.366	0.373	0.342
PBA	0.317	0.326	0.286

As mentioned earlier, the rankings are somewhat insensitive to changes in these weights. Although the rankings changed, most sites stayed in their relative groups (separated by the lines on the chart).

(2) The weight for BMAR was varied from 0.000 to 0.125 with the required change in weights redistributed among all the remaining attributes. The results are provided (see below). Again, ranking changes somewhat, but sites stayed in their relative groups.

	BMAR WEIGHT						
	0.1250	0.1000	0.0875	0.0625	0.0500	0.0250	0.0000
CAAA	0.756	0.737	0.727	0.708	0.700	0.688	0.685
MCAAP	0.675	0.670	0.668	0.664	0.662	0.660	0.660
SVDA	0.677	0.651	0.637	0.612	0.600	0.583	0.577
ANAD	0.655	0.634	0.624	0.605	0.597	0.584	0.580
HWAAP	0.479	0.522	0.545	0.593	0.617	0.657	0.673
TEAD	0.581	0.557	0.544	0.521	0.510	0.495	0.489
UMDA	0.572	0.541	0.525	0.494	0.480	0.459	0.450
MAAP	0.583	0.544	0.523	0.479	0.458	0.424	0.413
LEAD	0.570	0.532	0.512	0.471	0.452	0.420	0.408
RRAD	0.461	0.464	0.465	0.467	0.469	0.470	0.471
PUDA	0.534	0.499	0.480	0.444	0.427	0.400	0.390
LBAD	0.546	0.506	0.485	0.442	0.421	0.388	0.374
SIAD	0.468	0.447	0.436	0.417	0.408	0.396	0.394
SEAD	0.488	0.445	0.422	0.374	0.350	0.310	0.295
FWDA	0.489	0.446	0.422	0.373	0.348	0.307	0.290
RAAP	0.439	0.410	0.395	0.366	0.353	0.334	0.330
PBA	0.376	0.352	0.340	0.317	0.307	0.294	0.293

(3) Two rankings were made with changes in the weights given to readiness, efficiency and capability. In one, efficiency was given a weight of 0.4 and readiness a weight of 0.05. In the other, efficiency was given a weight of 0.4, capability 0.4, and readiness 0.15. The results are provided with the initial scores and rankings (see below) and show the stability of the relative groups.

	INITIAL SCORE		EFFICIENCY 0.4 READINESS 0.05			EFFICIENCY 0.4 CAPABILITY 0.4 READINESS 0.15		
1	CAAA	0.708	(2)	MCAAP	0.721	(2)	MCAAP	0.7158
2	MCAAP	0.664	(5)	HWAAP	0.702	(1)	CAAA	0.6918
3	SVDA	0.612	(1)	CAAA	0.681	(5)	HWAAP	0.6719
4	ANAD	0.605	(3)	SVDA	0.588	(3)	SVDA	0.6236
5	HWAAP	0.593	(4)	ANAD	0.583	(4)	ANAD	0.6126
6	TEAD	0.521	(6)	TEAD	0.487	(6)	TEAD	0.5265
7	UMDA	0.494	(8)	MAAP	0.480	(7)	UMDA	0.5243
8	MAAP	0.479	(7)	UMDA	0.477	(8)	MAAP	0.5237
9	LEAD	0.471	(9)	LEAD	0.452	(9)	LEAD	0.5205
10	RRAD	0.467	(10)	RRAD	0.433	(11)	PUDA	0.4890
11	PUDA	0.444	(11)	PUDA	0.422	(12)	LBAD	0.4885
12	LBAD	0.442	(12)	LBAD	0.416	(13)	SIAD	0.4528
13	SIAD	0.417	(13)	SIAD	0.398	(10)	RRAD	0.4431
14	SEAD	0.374	(16)	RAAP	0.372	(16)	RAAP	0.4138
15	FWDA	0.373	(15)	FWDA	0.328	(15)	FWDA	0.4105
16	RAAP	0.366	(14)	SEAD	0.307	(14)	SEAD	0.3901
17	PBA	0.317	(17)	PBA	0.291	(17)	PBA	0.3359

(4) The sensitivity analysis on outloading consisted of dropping the two outloading attributes and assigning the weight previously given to outloading to storage capability. The result is given below with the initial ranking for each site. Two noteworthy changes were Ravenna AAP, which changed from rank 16 to 11 and Umatilla which dropped from 7th to 15th.

	SITE	SCORE	PRIOR RANK
1	CAAA	0.80	1
2	MCAAP	0.74	2
3	HWAAP	0.73	5
4	SVDA	0.51	3
5	MAAP	0.47	8
6	ANAD	0.45	4
7	PUDA	0.43	11
8	LEAD	0.42	9
9	TEAD	0.42	6
10	LBAD	0.41	12
11	RVAAP	0.36	16
12	SIAD	0.35	13
13	RRAD	0.32	10
14	SEAD	0.31	14
15	UMDA	0.31	7
16	FWDA	0.30	15
17	PBA	0.29	17

5. GOCO SITES: At the request of AMSMC-DS this analysis was expanded to evaluate several AAPs. The methodology used to rank order these GOCO sites consisted of the following five steps:

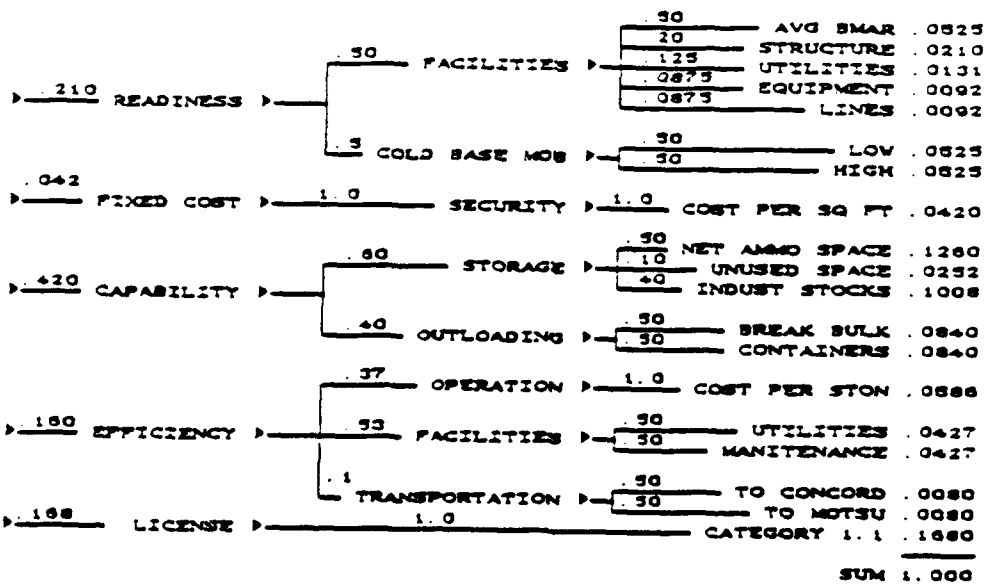
a. STEP 1. GENERATION OF A LIST OF ALTERNATIVE SITES. The list of alternative sites used in this analysis was developed by AMSMC-DS:

Indiana AAP
Joliet AAP
Kansas AAP
Longhorn AAP
Louisiana AAP
Mississippi AAP
Ravenna AAP

It should be noted that the only overlap between the GOCO sites above and the storage sites considered earlier in the report is Ravenna.

b. STEP 2. DETERMINATION OF THE SELECTION CRITERIA. A value tree was constructed to assist in developing the criteria and weights. This tree is provided below:

Value Tree for GOCO Site Selection



c. STEP 3. DATA COLLECTION. A definition of each attribute and the source of its value is provided in the appendix.

d. STEP 4. GENERATION OF A RANK ORDER LIST. The method used to combine the data values and weights to generate a rank ordering of the sites was the

Technique for Ordered Preference by Similarity to Ideal Solution TOPSIS. The TOPSIS score for each site is given below:

SITE	SCORE
Ravenna AAP	0.62
Kansas AAP	0.52
Mississippi AAP	0.51
Indiana AAP	0.50
Louisiana AAP	0.50
Longhorn AAP	0.47
Joliet AAP	0.46

e. STEP 5. SENSITIVITY ANALYSIS. The initial ranking was performed using the amount of space reserved for industrial stocks as an attribute to be minimized and the amount of unused ammunition space as an attribute to be maximized. Several sensitivity runs were made to determine the effect of modifying these attributes. In every run Ravenna was clearly preferred to the other sites.

(1) A ranking was made with industrial stock space replaced with net ammunition storage space less the space reserved for industrial stocks. The results are provided below:

SITE	SCORE
Ravenna AAP	0.69
Indiana AAP	0.55
Kansas AAP	0.44
Joliet	0.40
Mississippi AAP	0.39
Longhorn AAP	0.38
Louisiana AAP	0.38

(2) A ranking was made with industrial stock space replaced with net ammunition storage space less the space reserved for industrial stocks. Unused ammunition space was dropped and the weight given to net storage space less industrial stock space. The results are provided below:

SITE	SCORE
Ravenna AAP	0.66
Indiana AAP	0.58
Kansas AAP	0.42
Longhorn AAP	0.38
Mississippi AAP	0.37
Joliet	0.37
Louisiana AAP	0.36

(3) A ranking was made with industrial stock space replaced with net ammunition storage space less the space reserved for industrial stocks.

Unused ammunition space was dropped and the weight given to net ammunition storage space. The results are provided below:

SITE	SCORE
Ravenna AAP	0.71
Indiana AAP	0.53
Kansas AAP	0.43
Joliet AAP	0.40
Mississippi AAP	0.37
Louisiana AAP	0.36
Longhorn AAP	0.36

6. CONCLUSIONS:

a. Based on the ranking of depot type sites, BRAC I closure of depot activities seems reasonable.

b. In the near term, all ammunition storage is needed and future closure options are limited. In the long term, the storage crunch will be solved by the downsizing of the armed forces.

c. Greater emphasis should be given to investing to balance capabilities: for example, HWAAP is 1st in storage capability but 11th outloading via container.

d. Some form of decision analysis should be utilized when deciding which sites should be utilized.

e. Increased demilitarization is needed to provide storage space and reduce operation and support costs.

f. If the storage base were to be expanded by utilizing the seven GOCO plants ranked in this study, then Ravenna would be recommended over the other six plants. However, this analysis should not be construed as recommending that the ammunition base be expanded by utilizing this facility. For a much smaller investment it may be possible to expand the storage capability at depots and provide a significantly better long term alternative. It should also be noted that in the initial analysis in which Ravenna was compared to Crane, Hawthorne, McAlester, and several depots, it received a score significantly lower score than the sites making up the current storage base.

REFERENCES:

[1] Joint Ordance Commanders Group, Storage Manager's Handbook, 56th Edition. Compiled by HQ AMCCOM, AMSMC-DSC-L, 30 Sep 90.

[2] Joint Ordance Commanders Group, Storage Manager's Handbook, 57th Edition. Compiled by HQ AMCCOM, AMSMC-DSC-L, 30 Jun 90.

[3] AMCCOM Quarterly, Smaller Future Force Based on Diminishing Threat, Budget, AMCCOM Quarterly, Oct 1991.

[4] Von Winterfeldt, Detlof and Edwards, Ward, Decision Analysis and Behavioral Research, Cambridge University Press, Cambridge 1986, Navy Contract N00014-79-C-0529.

[5] Hwang C.L. and Yoon K., Multiple Attribute Decision Making Methods and Applications, Springer-Verlag, New York, 1981.

[6] Hwang C.L. and Tillman, F.A. Users Manual for Multicriteria Decision Making Support System, ALMC, ALM-64-3497-H1, 1987.

APPENDIX

AVG BMAR

The accumulation of projects identified which remain as a firm requirement (validated/approved by the Government), but were not currently funded. Source: The average of deferred maintenance reported in the FY 90 Departmental Industrial Reserve Plants/Maintenance Facilities Report and the Backlog of Maintenance and Repair reported in the Facilities Engineering and Housing Annual Summary of Operations FY 89.

STRUCTURE, UTILITIES, EQUIPMENT, LINES

The state of readiness of the plant's structures, utilities, equipment and lines. Source: FY 90 Departmental Industrial Reserve Plants/Maintenance Facilities Report.

LOW, HIGH MOB RESPONSE

An estimate of the time in months to obtain maximum output starting from a cold production base. Since in many cases multiple items are scheduled at the same facility, a range is provided representing the item taking the least time to reach maximum output and the item taking the most time to reach maximum output. Source: FY 90 Departmental Industrial Reserve Plants/ Maintenance Facilities Report.

ST DEMILITARIZATION

The number of short tons of demilitarization at a site. Source: CCSS and AMSMC-PD.

AMMO MY

An estimate of the number of man years spent on the ammunition storage mission at a site. Source: Depot Operations Cost and Performance Report, 3d Qtr, FY 90.

DET ABOVE, DET BELOW, BURN HE, BURN PROPELL

Measures of demilitarization capabilities by open burning and detonation. Source: AMSMC-DSM.

COST OF GUARDS

The annual security guard costs at a site. Source: AMSMC-SS.

NET AMMUNITION SPACE

The difference between gross storage space (above ground and earth covered magazines) at a site and the sum of unusable, outgranted, standby, and aisle, structural, support. Source: Joint Ordnance Commanders Group Storage Manager's Handbook, 30 Sep 90.

UNUSED SPACE

The difference between the net storage and space occupied by materiel, including vacant space restricted from use due to quantity/distance relationships, compatibility requirements, or criticality limitations. Source: Joint Ordnance Commanders Group Storage Manager's Handbook, 30 Sep 90.

INDUSTRIAL STOCKS

Storage space (above ground and earth covered magazines) at plants and arsenals that is used or reserved for storage of components, bulk explosives, and finished ammunition within the industrial account. Source: Joint Ordnance Commanders Group Storage Manager's Handbook, 30 Sep 90.

BREAK BULK

An estimate of the site's maximum capability to ship via break bulk. Source: CY 89 CONUS Outloading/Receiving Capability Reports.

CONTAINERS

An estimate of the site's maximum capability to ship via containers. Source: CY 89 CONUS Outloading/Receiving Capability Reports.

COST PER SHORT TON

Average yearly cost depot operations per short ton of ammunition stored. Source: AMSMC-DSA.

RECEIPT, ISSUE, REWAREHOUSE, TOTAL COSTS, COMIS, INVENTORY

Estimates of the cost of various ammunition storage operations. Source: Depot Operations Cost and Performance Report, 3d Qtr, FY 90.

UTILITIES

Annual cost of operation of utilities at a site measured in dollars per population served. Source: Facilities Engineering and Housing Annual Summary of Operation FY 89.

MAINTENANCE

Annual cost of maintenance of real property at a site measured in dollars per thousands of square feet. Source: Facilities Engineering and Housing Annual Summary of Operation FY 89.

TO CONCORD

An estimate of the land transportation cost (in dollars per short ton) for shipments thru Concord. Source: AMSMC-TM.

TO MOTSU

An estimate of the land transportation cost (in dollars per short ton) for shipments thru MOTSU. Source: AMSMC-TM.

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